AN ESTIMATE OF THE RANGE AND POPULATION LEVELS OF FISHER'S ESTUARINE MOTH (*GORTYNA BORELII LUNATA* FREYER), (LEP.: NOCTUIDAE) IN ESSEX, JULY AND OCTOBER 1996

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Fisher's estuarine moth (*Gortyna borelii lunata* Freyer) was first discovered in 1968 by Mr Ben Fisher at a lighted window of his home at Beaumont-cum-Moze in Essex. It was soon realized that the only home of this insect in the United Kingdom is the islands and inlets of nearby Hamford Water where it is an internal feeder on hog's fennel (*Peucedanum officinale* L.). The moth is illustrated in Skinner (1984) Plate 39, Fig. 3. The Essex Wildlife Trust has monitored the population of adults by mercury vapour light and by searching with torches on its Skipper's Island reserve almost every year since 1971. This monitoring has generally yielded very small numbers of moths, with three years showing none, and an average of under 14 individuals in years when the insect appears. Recent years have generally been better and 33 adults were recorded in 1995 (Table 1). These results have led to the conclusion that the moth exists at relatively low population levels and is subject to wide fluctuations in numbers from year to year. My understanding is that no attempt is made to standardize recording effort and methods, and it seems possible that this may contribute to the variation in results. Larval surveys have also been undertaken but the results are not available. BENHS members who have visited the Hamford Water area over the years report that the larvae are easy to find and often common in June and July, and that adults are fairly common at mercury vapour light later in the year. It has been reported to us that sixteen adults were recorded at light one night in the autumn of 1995. At a council meeting of the BENHS in 1996 concern was shown

Year	Skipper's Island	Beaumont Quay
1971	7	–
1972	9	–
1973	0	–
1974	0	–
1975	1	–
1976	25	–
1978	12	–
1979	40	–
1981	0	–
1983	13	–
1986	4	–
1994	11	–
1995	33	–
1996	9	~17
1997	–	14

Table 1. Essex Wildlife Trust annual survey for adults of *G. borelii*.

The number of damaged stems on a plant	The number of plants showing this damage
1	20
2	16
3	24
4	18
5	12
6	4
7	6
8	3
9	2
10	0
11	2
12	1
16	1
19	1
22	1
25	1

Table 2. Frequency of damaged stems per plant.

over the disparity between the abundance of *G. borelii* as reported by the Essex Wildlife Trust and in reports from our own members, particularly as this information may be used as the basis for legislation. In addition the exact range of the species within the Hamford Water area was not known with certainty. In an attempt to reconcile these facts a survey was organized to gain information about the current range of the moth together with an indication of population levels at some of the sites.

Methods

Two main methods of surveying for *G. borelii* were considered. The first was searching for larval workings in the summer and the second was attracting adults to mercury vapour light and searching with torches in October. A survey of larvae in July was considered to be the most effective for a number of reasons. In early July the larvae feed by mining the lower part of stems of the foodplant. They are growing rapidly at this time and produce copious amounts of white frass from the holes in the stem which makes their presence easy to detect. Many plants can be searched and several sites surveyed with relative ease during the course of a day. The white frass is unique to *G. borelii*; no other insect is known to feed on hog's fennel in this way. If mercury vapour lights were used to attract the adults this would be subject to the uncertainties of the autumn weather and other factors which define a good or bad night. On a given night not all adults may fly; when both lights and searching are used about half the records are of moths quietly at rest on or near the foodplant. Some moths may not yet have emerged from the pupa; others may have flown away or died. Finally, with one set of lights only one site can be surveyed per night. In the event both methods were used although the larval survey produced almost all the records.

The larval survey

The survey team consisted of Reg Arthur, Joe Firmin, Colin Hart, Alan Jenkins, Colin Plant and Bernard Skinner. We arranged to meet near Beaumont Quay on the morning of 12 July 1996 and searched a few plants which grow alongside the B1414 road. We soon discovered that most of the plants had several stems which showed signs of feeding damage but did not contain larvae. Our original information was that the larva enters a stem of hog's fennel at a leaf axil a metre or so above ground and mines its way down, finally leaving the stem near ground level. Closer examination of several plants showed a pattern of stems with progressively larger entrance holes and larger frass pellet size. In stems with smaller holes there was a tendency to yellowing of leaves and stem. On a typical plant there would be three damaged stems and sometimes a pile of frass on the crown of the plant suggesting a larva was now feeding on the underground stem. We confirmed the presence of a larva in a stem only about three or four times. This was because we wanted to minimize disturbance to the larva and its foodplant, and also it is much quicker to count stems exuding frass than to split each stem open and search for the larva within. Without further detailed research we cannot prove that each larva feeds in about three stems before going down to the rootstock, but our field observations suggested that this is probably the case (Table 2). An alternative view is that each larva feeds in only one stem and mortality at this stage is very high, although this seems less likely.

In the early 1970s Don Down reared *G. borelii* through its whole life cycle and found that the second and third instar larvae move from one stem to another when

the pith on which they feed is mostly exhausted. This was seen when larvae were reared in boxes and also when feeding on a growing plant of hog's fennel (D. Down, *pers. comm.*). The larvae are dark purple in colour with a pale band between each segment; almost all larvae which are internal feeders are entirely pale coloured. When removed from their feeding place the larvae are active and able to move relatively quickly; both these factors are characteristic of species which move from one stem to another as part of their normal feeding pattern. We assumed that each larva utilized about three stems and for this reason we divided the number of damaged stems recorded on a plant by three to estimate the number of larvae on that particular plant.

The season was slightly advanced and to judge from the conical piles of frass on some of the rootstocks a number of larvae were now feeding underground. The team felt that this did not detract from the survey as the damaged stems exuding frass remain visible for some weeks after the larva has left the stem. A few plants had a large number of damaged stems; 25 was the highest number recorded on a single plant. At this site every plant large enough to support a larva showed signs of feeding damage. It is known that larvae can be cannibalistic when feeding in the rootstock, so on smaller plants only one larva may reach maturity.

We moved on, monitoring a line of plants which grow on the bank of a small brook between the road and the farm near Beaumont Quay. On reaching the sea we were presented with a long area of coastal grassland which stretched along the sea-wall towards Landermere and extended back to the borrowdyke drainage system. This area was scattered throughout with hog's fennel plants. We split into three groups of two and spent the rest of the morning counting plants and larvae in this area on the south side of the inlet (Table 3). A large number of plants were examined and larvae were found on approximately one plant in three. In total 12 man hours were spent on the morning survey.

In the afternoon, having first obtained permission for the visit, CH, AJ, CP and BS visited Exchem Organics at Bramble Island and spent the rest of the day surveying several sites in this extensive locality. In some places hog's fennel was abundant, forming the dominant vegetation over a considerable area. One stand of foodplant was estimated to be half an acre in extent (locally identified as building M17) and another over an acre (P4-Z4). Each site must have contained thousands of plants. Rabbits were present and their grazing had affected the ground vegetation considerably. Rabbits will only eat hog's fennel when their normal food is in short supply, possibly because hog's fennel is distasteful, but almost all other low plants were heavily grazed almost to the point of extinction. With no competition the hog's fennel had formed dense patches up to six feet in height. On these sites it was unrealistic to survey all the plants and so one or more sample areas were paced out and all the plants within the area were monitored. Despite the abundance of foodplant we found relatively few stems damaged by larval feeding (Tables 3 and 4). However, one remote site on Bramble Island resembled the Beaumont Quay-Landermere site in that it consisted of an isolated stand of six mature plants amongst dense grass. All the plants here showed signs of feeding. The afternoon survey occupied 12 man hours.

On the following day two of us (CH and BS) searched other areas surrounding Hamford Water but with very poor results. We searched for colonies of hog's fennel at several sites where the plant had been recorded previously (Thornton, 1990). Only one stand of the plant was found and this was near to a marina at the channel called The Twizzle (TM 247232). The site was a few yards outside the marina fence and contained only twenty plants, many of them tiny. Despite the isolation and small size of the site eight of the plants were inhabited by larvae.

Site description	Total number of plants examined	Plants damaged by borelii larvae	Samples of numbers of damaged stems per plant	Average number of larvae per damaged plant at this site	Estimated total number of larvae
Beaumont Quay—roadside	15	15	3,8,7,4,12,3,11,3,4,2,5,5,5,3,3	1.73	26
Beaumont Quay—N. side of road	22	17	3,7,11,5	2.17	37
Beaumont Quay—riverbank	8	5	4,5,6,16,22	3.53	18
Beaumont Quay—sea wall	13	9	5,5,9	2.11	19
Beaumont Quay—sea wall JF	32	26	25,1,4,3,1,4,6,3,5,1,4,4,1,4,19,2,3,1, 3,3,5,3,2,4,4,7	1.56	41
Beaumont Quay—marsh JF	20	15	1,1,2,7,1,8,3,1,1,5,4,1,4,2	0.98	15
Beaumont Quay JF	9	5	4,2,3,3,3	1.00	5
Beaumont Quay—behind sea wall	9	6	8,4,6,6	2.00	12
Beaumont Quay—to concrete sluice	37	34	5,2,9,3,2,3,1	1.19	40
Beaumont Quay—sea wall to E.	11	7	7,3,3,	1.44	10
Kirby Quay—west side	5	0			0
Kirby Quay—east side	2	0			0
Birch Hall west	0	0			0
Birch Hall east	0	0			0
Opposite Skipper's Island	0	0			0
Kentshill Farm—roadside	0	0			0
Bramble Island—old jetty shed	6	6	4,4,2,2,2,1	1.00	6
Bramble Island—balsa grinding	6	1	1	1.00	1
Marina—eastern edge	20	8	3,3,4	1.00	8
			Estimated total larvae =		238

Table 3. *G. borelii* larval data at sites where all plants were examined.

Site	Site name	Estimated total site area (acre)	Percentage of area sampled	Total number of plants examined	Plants damaged by borelii larvae	Number of damaged stems per plant on a sample of damaged plants (generally 1 plant in 5)	Average number of larvae per damaged plant at this site	Estimated total number of larvae in sample area	Estimated total number of larvae at each site
A	Bramble Island—M17			32	9	2,1,2,1,1	0.47	4.20	
A	Bramble Island—M17 near pond	0.5	2%	25	11	1,2,3,3	0.75	8.25	318
A	Bramble Island—M16			12	12	1,1,2,2	0.56	6.66	
B	Bramble Island—expl test P4-Z4	1.25	4%	38	11	7,5,4	1.77	19.47	486
						Estimated total larvae =			804

Table 4. *G. borelii* larval data at two sites on Bramble Island, Essex, where a sample of plants were examined.

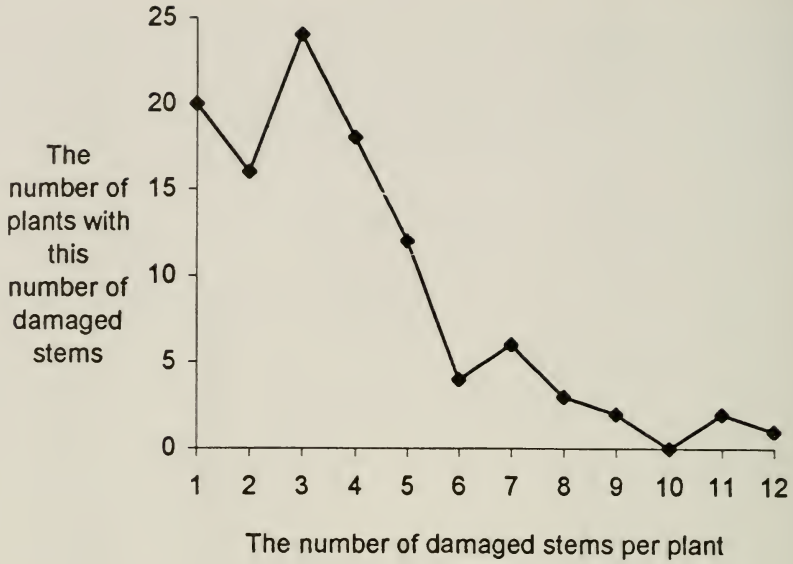

Fig. 1 Frequency of damaged stems on hog's fennel plants.

Fig. 2. Running lights for *G. borelii*, Bernard Skinner, Malcolm Braithwaite, Joe Firmin, Reg Arthur and an Exchem employee.

A few days later CP returned to the area to survey other mainland sites. At Kirby Quay only seven plants were seen and no larvae. Three sites near Birch Hall and facing Skipper's Island were covered with soil from dyke working, apparently in 1993 or 1994, and the plants appeared to have been destroyed.

Most of the sites we visited contained a limited number of plants which allowed every plant to be examined individually for larval damage. We recorded the total number of plants present, and the number which showed signs of feeding larvae. One in every five plants which showed signs of feeding was examined more closely and the number of damaged stems on that plant was counted and recorded.

In the few localities with large stands of foodplant one or more representative areas were selected and all the plants in those areas were examined as before. The total number of larvae was estimated from the proportions of the sample areas to the whole area.

It was earlier mentioned that we formed the opinion that each larva mines about three stems before feeding in the rootstock. This information was unexpected. However, as we had counted all the damaged stems on over 100 plants it was possible that this data may indicate that there were more plants with three and six damaged stems than other numbers. Fig. 1 shows the numbers of plants with each number of damaged stems and does show a peak at 3 stems and may show a second at 7. It must be pointed out that the number of plants with more than 6 damaged stems is low and that this data has not been subjected to any statistical analysis, therefore no firm conclusions can be drawn.

The survey for adults

On 10 October 1996 six members of the BENHS and about eight Exchem employees gathered at the Exchem works on Bramble Island to search and run lights for *G. borelii* (Fig. 2). Six mercury vapour lights were run in two large stands of hog's fennel, the first at P4-Z4, and the second nearby, adjacent to the main access road. An additional area near building M17 was searched by torchlight. Despite over a dozen people actively searching for three hours, only one moth, a freshly emerged female, was found. This moth was discovered at rest on the foodplant near to the access road. It was admired by all present and was photographed before being released at the end of the evening. It was not a good night for running lights as the weather that day was cold and wet, but at least the rain held off for the evening. Despite the poor conditions the Exchem employees searched with enthusiasm and showed a genuine interest in their special moth. I was very thankful that we did find at least one Fisher's estuarine moth to show them. The six mercury vapour lights produced only seven macro species between them. On the way home at about 11 pm we stopped at Beaumont Quay for a quick look over a few easily accessible plants. One moth, again a female, was seen clinging to a dead flower head of hog's fennel.

Although not part of this survey an account of an adult moth attracted to a light states, 'It approached a light at 2300 hours, arrived at high speed and crashed in and around like a large yellow underwing before dropping into the Skinner trap. It gave the appearance of being strongly attracted' (R. Arthur, *pers. comm.*).

Conclusions

It has been suggested (P. Waring, *pers. comm.*) that the population of *G. borelii* in the Hamford Water area constitutes a single large colony. This means that there is annual mixing of sub-populations from different sites, and even a few moths on a

handful of isolated plants can still be part of the main colony. The discovery of about six larvae on a small isolated stand of foodplant (at The Twizzle) tends to support this view. With only two exceptions we found larvae present wherever we found a few plants of hog's fennel. On some sites almost every plant showed signs of feeding damage. *Gortyna borelii* is also present on Skipper's Island and probably other islands which we did not visit. The situation on Bramble Island is very different. Here there is plenty of foodplant but the population density appears to be much lower than at other sites. Research is needed to find out why this apparently excellent resource is not better used. We did notice that pheasants were present at Bramble Island and rabbit grazing was very heavy, resulting in an almost complete absence of grass cover in some areas.

In 1990 Thornton's survey of hog's fennel identified twenty colonies of the plant. In 1996 the current survey visited fourteen of these colonies and found that hog's fennel had disappeared altogether from three of the smaller sites. It was worrying to see that there was a marked reduction in the number of plants at several other sites. This reduction has been caused by dumping soil from dredging or sea defence work and certain farming activities, including ploughing.

Hog's fennel is a robust plant; once established the underground stem can withstand drought, severe cutting as part of scrub clearance, and being buried, at least by a couple of feet of soil. However, dumping several feet of soil onto a plant in the course of channel dredging or reinforcing sea defences will kill it, together with any larvae which may be present. General farm activities such as ploughing and re-seeding rough pasture which previously contained hog's fennel have seriously reduced the number of plants in the fields around Beaumont Quay.

Probably the most serious single threat to the survival of *G. borelii* is mowing the hog's fennel to discourage scrub invasion. In early summer the insect is present as small larvae feeding high up in the stems of hog's fennel. If a site is mown at this time of year it will kill almost all the larvae present. A single cut, taken in August when the larvae are feeding in the underground stems, will greatly reduce the risk to this species. The overwintering eggs are laid on dead grass and hog's fennel stems and leaves. This material should be left *in situ* at the end of the summer and not tidied up or burnt. On many sites the amount of foodplant has reduced over the last ten or fifteen years and this gave us cause for concern. Conservation efforts should be directed towards maintaining a healthy population of hog's fennel plants, especially in those areas identified as favoured habitats for *G. borelii*.

Summary

In a survey which spanned only three days and did not visit several good sites on islands, we found evidence for nearly 1000 larvae; the true population can only be guessed at but must be at least several times this figure. With two exceptions larvae were found at every site which still carried the foodplant, although at some sites the population density was low. At favoured sites all mature plants carried larvae and at most other sites about 30% of plants showed feeding damage. It was not clear why some sites had a very high level of larval damage while at other sites quite close by damage was rare. At all the favoured sites we noticed that hog's fennel grows amongst long rank grass which had to be parted to see the base of the stems. At Bramble Island, where larvae were rare, we noticed that rabbits and pheasants were common and hardly any ground layer vegetation was present. Further research is needed to find the exact conditions which *G. borelii* requires in order to thrive. While breeding the moth in the 1970s Don Down found that eggs were laid in rows tucked

into the sheaths surrounding the stems of long grass, in a very similar manner to that adopted by the White-point (*Mythimna albipuncta* D. & S.) and other members of this genus.

The overall impression is of an insect which is common as a larva in some favoured areas and appears to have increased in numbers in the past few years, but exists at a low level in adjacent and superficially similar areas.

Since the survey was completed it has become generally agreed that considerable mortality occurs between half-grown larvae and adult moths. This will clearly have an effect on results of the larva survey and the cause of this loss is an urgent area for further research. One result of this survey is to highlight the fact that our knowledge of the exact habitat requirements and life history of *G. borelii* is far from complete. Research is needed in several areas and BENHS members should continue to play their part. Amateurs often have more time for monitoring and research than the professional who is necessarily driven by contracts and deadlines. An unintentional side-effect of this survey has been to unearth information on egg-laying and larval feeding which may have considerable conservation importance. One effect of Schedule 5 listing would be to curtail this unofficial amateur research.

In January 1998, just before this report was completed, news of the Essex Sea Wall Management Experiment was received from English Nature. This experiment will subject sections of the sea wall which hold *G. borelii* to four different management regimes. In coming years the fauna and flora will be monitored in detail to record the impact of the different regimes. I should add that all four regimes appear to be an improvement on the management practised up to 1996. The most appropriate regime will be considered for management of other sea walls in Essex and will contribute to the Biodiversity Action Plans for *Gortyna* and *Peucedanum*. It should be remembered that the first priority of a sea wall is to maintain the sea defences, but maintenance of hog's fennel and *G. borelii* are also high priority. The note concludes with the sentence: 'If . . . interested parties would like to take part in the relevant aspects of this experiment in future years, I would love to hear from you.' Interested members should contact Dr Chris Gibson, English Nature, Harbour House, Hythe Quay, Colchester, Essex CO2 8JF.

Caution

Many of the sites for *G. borelii* are private property and some of the landowners do not tolerate trespass. Bramble Island is a prohibited area and permission is rarely given for access. We were accompanied by Exchem staff at all times. The conservation of *G. borelii*, its foodplant and environment depend on co-operation between entomologists, conservation bodies and local landowners and this should not be jeopardized.

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Postscript

In early 1997 the Department of the Environment invited submissions from interested parties on the proposed addition of *G. borelii* to schedule 5 of the Wildlife and Countryside Act (1981). On 4 June 1997 a draft of this paper together with a covering letter setting out the views of Council were submitted to the Species Conservation Branch of the D.O.E. in Bristol.

SHORT COMMUNICATION

Troilism in *Sicus ferrugineus* (L.) (Diptera: Conopidae)—I was interested to read the recent account in this journal of delayed mating in two males and one female of *Conops quadrifasciata* Degeer (Uffen, R. W. J. *Br. J. Ent. Nat. Hist.* 1998; **11**: 30, Plate I, Fig. 2). Many years ago I remember finding three specimens of *Sicus ferrugineus* locked together as one and running around in the sun on a sycamore leaf. At the time I was more interested in the discovery of what was to me then a new and exciting fly than the possibility that I had observed some sort of mate-guarding behaviour.

My memory was jogged a couple of years ago when another interesting short note in this journal reported two males of the sand wasp *Ammophila sabulosa* (L.) (Hymenoptera: Sphecidae) jostling for the attention of a single female (Callow, N. A. *Br. J. Ent. Nat. Hist.* 1991, **4**: 96, Plate IV, Fig. 2). I thought then to write a short comment on my conopid observations, but time slipped by until the appearance of the recent *Conops* note.

The three specimens of *Sicus* still stand in my collection: two males and a female of *Sicus ferrugineus*, taken together '*in copula*' on a sycamore leaf in the sunshine, in the woods above Denton, East Sussex, 30.vii.1970. I clearly recall taking the threesome on a hot July day. Unlike Uffen's tenacious trio, the three *Sicus* separated in the net; one male crawled loose while the true mating pair remained together.

Mate guarding must be quite common in the Conopidae; I have several times seen pairs sitting about on flowers, a male and a female, clinging together, but obviously not coupled. In Nunhead Cemetery and other sites in south-east London I regularly see unattached 'couples' of both *Conops quadrifasciata* and *Conops ceriaeformis* Meigen (the commonest species in this area), sitting together, especially on ragwort flowers.

As with other examples of mate-guarding behaviour, it is probably competition for females which drives the males to invest time and effort in hanging around after the copulatory act. Certainly male conopids always seem to outnumber females, both in the field and also in dipterists' collections.—Richard A. Jones, 13 Bellwood Road, Nunhead, London SE15 3DE.